

Municipal Advisory Board

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MAB Guidelines for HDPE Pipeline Inspection

(MAB-6 2020)

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FOREWORD

This guide was developed by the Municipal Advisory Board (MAB) and published with the help of the members of the Plastics Pipe Institute, Inc. (PPI).

This publication is intended as a guide for engineers, users, contractors, code officials, and other interested parties for use in the design, construction and installation of high-density polyethylene (HDPE) pressure water piping systems. The local utility or engineer may need to modify this guide to adapt the document to local conditions, operations, and practices.

This guide has been prepared by MAB members and associates as a service to the water industry. The information in this document is offered in good faith and believed to be accurate at the time of its preparation, but is offered “as is” without express or implied warranties, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Any reference to a specific manufacturer’s product is merely illustrative, and not intended as an endorsement of that product. Reference to or testing of a proprietary product should not be construed as an endorsement by the MAB or PPI, which do not endorse the proprietary products or processes of any manufacturer. Users are advised to consult the manufacturer for more detailed information about the specific manufacturer’s products. The information in this document is offered for consideration by industry members in fulfilling their own compliance responsibilities. MAB and the PPI assume no responsibility for compliance with applicable laws and regulations.

The MAB serves as an independent, non-commercial adviser to the Municipal & Industrial (M & I) Division of the PPI. Once adopted, MAB will consider revising this guide from time to time, in response to comments and suggestions from the users. Please send suggestions of improvements to Camille George Rubeiz, PE, F. ASCE, at crubeiz@plasticpipe.org.

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MAB-6 INTRODUCTION / EXPLANATION OF APPENDICES

INTRODUCTION

With the adoption of HDPE as a potable water distribution system material it has become increasingly important that owners of these systems ensure that the benefits associated with this material are not compromised by non-standard installation techniques. With the advent of HDPE 4710 materials, which are resistant to stress cracking, the leading cause of failure is installation error followed by third party damage. The purpose of this document is to standardize the inspection of piping installations. The HDPE Municipal Advisory Board (MAB) members identified the issue of achieving consistent inspection and created a task force to develop this document. The MAB membership consists of municipal water companies/cities staff, college researchers, contractors and designers all involved in furthering the proper adoption of HDPE potable water systems.

MAB Mission Statement: *To improve the design, installation, and operation of municipal HDPE water piping systems through the creation of partnerships among utilities, researchers, designers, contractors, and the HDPE industry.*

Project Inspectors have historically been responsible for all aspects of daily construction inspection and there are numerous documents currently available addressing all other aspects of construction inspection. The focus of this document is limited to HDPE issues only and does not attempt to address other aspects of pipeline inspection.

NOTE to OWNERS: This document is intended for water system owners adopting HDPE pipe to improve project construction success. In the event that the owner has a high level of experience with HDPE, portions of the following document may already have been incorporated in the construction process. These guidelines were prepared for water systems owners with limited HDPE experience.

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HDPE INCOMING MATERIAL INSPECTION/QC (Appendix A)

Inspectors should verify that all HDPE related materials comply with project specifications, are free of defects, were stored properly, manufactured within stated timelines and did not suffer handling damage. Appendix A provides sample material acceptance forms which should be utilized to document that the provided piping products are within specification, new and damage/defect free.

HDPE EQUIPMENT QUALIFICATION (Appendix B)

All tooling used in the construction of HDPE piping systems must be maintained in accordance with the manufacturer's recommended practices and the functionality of this tooling should be verified by the Inspector responsible for observing fusion. Appendix B includes sample check lists and tags which can be attached to all approved tooling. Provided tooling must cover the ranges of diameters specified for each individual project. Maintenance of this tooling during the project is critical for successful fusion fabrication. Inspectors should verify adequacy of tooling on a frequent basis by direct observation and subsequently approve replacement tooling during the duration of the project. A few examples include: verifying heating iron temperatures, cleanliness/coating condition of heating iron faces, measuring peel thickness of scrapers, working condition of all moving parts to verify alignment and free movement, type of alcohol and cloth used for surface cleaning, appearance of produced fusion beads and in some instances destructive testing of fused joints in accordance with specified ASTM standards (Appendix E).

HDPE CONNECTION INSPECTION (Appendix C)

All employees (contract or in-house) performing fusion must be qualified on a determined frequency (ex. annually). Additionally, if unacceptable (visual appearance, methodology, inappropriate or damaged tooling utilized, etc.) or failed fusion are encountered, that fusion technician must be requalified and not allowed to continue fusion until requalification has occurred. The fusion technician always has the discretion to remove questionable fusions before placing these joints into service without penalty or requalification.

The opportunity to conduct the fusion technician qualification can be achieved during the Tooling Qualification process using the configuration of tools/equipment in a "field" type setting. The "Qualifying" body (fusion equipment manufacturer or the Owner) shall have the capability to destructively test prepared joints per applicable ASTM standards (Appendix E). A joint of each type of fusion should be prepared for destructive testing and Qualification issued for each type specified (butt fusion (manual and hydraulic), socket fusion, sidewall fusion (branch and tapping tee), electro fusion (coupling, sidewall)). Fusion technicians shall only be able to fabricate the type of fusions for which they are Qualified. It is required that fusion cards be issued to these Qualified fusion technicians allowing field verification by Inspector. The Inspector should witness all fusion qualification efforts including observance of all tooling and fusion methodology to ensure compliance with established procedures.

ONLY QUALIFIED FUSION TECHNICIANS CAN PERFORM FUSION

It is recommended that all Inspectors assigned to observe HDPE fusions should also be qualified for the specific processes (butt, socket, sidewall, electro (couplings, sidewall)) being observed.

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Project Specifications should include detailed fusion procedures for all methods utilized in constructing HDPE piping systems or at a minimum follow ASTM standards for heat fusion and/or MAB documents for electrofusion. These detailed fusion procedures are critical for the Inspector to both qualify fusion technicians and provide reference support when observing fusion activity on the jobsite. Two different documents are provided, one for 12" and under and another for 14"-30" diameter electrofusion fittings. Both of these procedures were developed and approved by all electrofusion manufacturers offering products in the North American water market. Additional information is provided in Appendix E.

For fittings above 30", specific electrofusion manufacturer procedures, developed for their unique products, shall be used.

The leading cause of failure associated with HDPE 4710 piping systems is improper installation. It is critical that fusion methods (including all associated tooling) be followed exactly as stated with no allowance for any variation. Typical failures are related to:

- Unqualified installers
- Improper tooling/lack of tooling/non-maintained tooling/substituted non-manufacturer approved tooling
- Inadequate removal of oxidation layer
- Improper solutions used for cleaning
- Lack of adherence with fusion procedures
- Misuse/non-use of clamping/alignment devices
- Non-adherence with required cooling times
- Reliable generator output/undersized generators/lack of required power due to use of inadequate extension cords
- Inadequate pressure capabilities for in service conditions (improper pipe/fitting design),
- Installer shall mitigate adverse weather conditions (rain, snow, etc.) by using a tent or other suitable means at the joint location to avoid contamination during fusion.

It is critical that all the above listed items be addressed to produce systems that will provide predicted in service life (100+ years) associated with HDPE 4710.

Ideally each fusion performed in the field should be inspected by a HDPE qualified Inspector before burial. Forms for reporting each fusion (butt, socket, sidewall, electro (couplings, sidewall)) are provided in Appendix C. Completion of the attached forms for each fusion will provide oversight, quality control and avoid improper fusions from being placed into service.

Regular monitoring of several items will improve overall fusion quality at the jobsite including:

- Persons performing fusion are verifiably qualified.
- Tooling/machinery required for fusion has been qualified (based on presence of tags as outlined in Appendix B) and remains in good working order.
- Fittings and pipe have been quality controlled upon delivery to jobsite (Appendix A).
- For processes requiring removal of exterior wall surfaces such as, heated tool or electrofusion sidewall or couplings, a minimum removal of 0.007" thickness is required.
- Adherence to adopted fusion procedure(s).
- Proper clamping is used.

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- Required cooling times are observed prior to movement, removal of clamps, tapping and pressure testing.
- Ability to determine if electrofusion process requires abandonment of fitting or if the fusion power cycle can be repeated after observance of required cooling time.
- 96% or greater isopropyl alcohol cleaning agent used with clean lint free cloth.

Fusion Technicians should always mark their name, employee number, time at end of fusion and the time when the cooling period is complete as a minimum on the pipe adjacent to each fusion/fitting with an approved marker. These markings convey “ownership” of the fusion and if photographed can be included on the appropriate fusion report. Some agencies require additional information in these markings including but not limited to service address, tap number, date of installation or other relevant information.

Additionally, both butt and electrofusion automated processes have the capability to record fusion data and in some cases Geo-positional data that will assist with mapping record creation and improve the ability to find this fusion/fitting after burial.

After installation error, the next leading cause of failure, associated with HDPE 4710, is third party damage. If excavation requires an 811 call prior to activity (most locations), it is critical that mapping records are accurate. Including a tracer wire, installed during pipe installation, is another locating tool that can be invaluable when mapping records are missing/inaccurate or surface benchmarks change over time.

HDPE PRESSURE TESTING (Appendix D)

Pressure testing can only occur after cooling times have been observed post fusion. Intermediate pressure testing during construction is suggested for all sidewall connections either fused (heat or electrofusion) or mechanical. This intermediate testing will allow the abandonment in place of failed fusion sidewall fittings before the mainline pipe is tapped and reduce the likelihood of questionable fusions being placed into service (Appendix C). Appendix D contains a form for witnessing system pressure testing before system tie-in and disinfection activities. Further information on pressure testing HDPE is available in ASTM F2164, *Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure*.

OTHER SOURCES OF INFORMATION (Appendix E)

Additional information from multiple sources related to HDPE Potable Water Systems is provided.

HDPE PIPE TABLES PER AWWA C901 & C906 (Appendix F)

Refer to tables for pipe sizes, OD, DR, wall thickness and tolerance for CTS, IPS and DIPS sizes.

PROJECT CLOSE OUT

All completed forms should be collected and scanned into the electronic project file. Fusion records should also be downloaded and associated with these forms. Electrofusion power supplies typically house a USB connection that downloads onto a thumb drive in a spreadsheet format. Automated heat fusion equipment also provides data download capabilities including cloud storage.

MAB-6 APPENDIX A: HDPE INCOMING MATERIAL INSPECTION/QC FORM

Project Name: _____ Project Number: _____
Inspector Name: _____ Employee Number: _____
Date: _____

PIPE

All of the following data is available in the print line of the pipe. (One form should be completed for each pipe OD delivered)

Pipe Supplier/Vendor Name: _____

Manufacturer Name: _____ Manufacturer Date: _____

Manufacturing Standard: ☐ C906 (AWWA) ☐ C901 (AWWA) ☐ Other (ex. ASTM F714)

Material Certification: ☐ NSF 61 ☐ Other _____

Type of HDPE Material: ☐ PE4710 ☐ Other _____

Diameter Sizing: ☐ CTS ☐ DIPS ☐ IPS ☐ Other _____

Pipe OD: _____ inches

Pipe Pressure Class (PSI)/SDR: ☐ 250/9.0 ☐ 200/11.0 ☐ 160/13.5 ☐ 125/17 ☐ Other _____

See Appendix F for pipe dimension standards.

Pipe Packaging: ☐ Coil Length of coil _____

☐ Straight Lengths- Individual Length: ☐ 40ft ☐ 50 ft ☐ Other _____

Total Length Delivered: _____ ft

Damage:

Manufacturing Defect: ☐ Out of tolerance OD

☐ Out of tolerance ID

☐ Charred material in pipe

☐ Voids/ Inclusions/ Non-uniformity/ inconsistent pigmentation

☐ Mismatching

☐ Other: _____

Handling/Shipping: ☐ Scratching/ Gouging/ Other defects

☐ Strapping (band damage)

☐ Lifting equipment damage

☐ Missing end caps

Amount of Pipe Rejected: _____ ft

Amount of Pipe Accepted: _____ ft

MAB-6 APPENDIX A: HDPE INCOMING MATERIAL INSPECTION/QC FORM

Project Name: _____ Project Number: _____
Inspector Name: _____ Employee Number: _____
Date: _____

BUTT END FITTINGS

All supplied fittings should either have indentation or stickers indicating the following. (One form should be completed for each fitting OD and type delivered)

Fitting Supplier/Vendor Name: _____

Manufacturer Name: _____

Manufacturing Standard: _____

Type of HDPE Material: ☐ PE4710 ☐ Other: _____

Material Certification: ☐ NSF 61 ☐ Other: _____

Diameter Sizing: ☐ CTS ☐ DIPS ☐ IPS ☐ Other _____

Fitting OD: _____ inches

Pressure Class (PSI): ☐ 250 ☐ 200 ☐ 160 ☐ 125

Type Fitting: ☐ Elbow ☐ Tee ☐ Reducer ☐ Other _____

Typically, dependent on size, fittings are stored indoors and/or in boxes to prevent outside element damage (sun, excessive heat, flooding, etc.) and manufacturing date may be unknown. Specifications may state maximum duration from manufacture to delivery date.

Damage: Manufacturing Defect: ☐ Out of tolerance OD

☐ Out of tolerance ID

☐ Inadequate OD controlled pup lengths

☐ Mismatching

☐ Other: _____

Handling/Shipping: ☐ Weathering (not stored indoors)

☐ Visible damage

Total number of fittings delivered: _____

Number of fittings rejected: _____

Number of fittings accepted: _____

MAB-6 APPENDIX A: HDPE INCOMING MATERIAL INSPECTION/QC FORM

Project Name: _____ Project Number: _____
Inspector Name: _____ Employee Number: _____
Date: _____

SIDEWALL FITTINGS

All supplied fittings should either have indentation or stickers indicating the following. (One form should be completed for each fitting OD and type delivered)

Fitting Supplier/Vendor Name: _____

Manufacturer Name: _____

Manufacturing Standard: _____

Type of HDPE Material: ☐ PE4710 ☐ Other: _____

Material Certification: ☐ NSF 61 ☐ Other: _____

Main Diameter Sizing: ☐ IPS ☐ DIPS ☐ Other _____

Main Diameter: _____ inches

Outlet Diameter Sizing: ☐ CTS ☐ IPS ☐ DIPS ☐ Other: _____

Outlet Fitting OD: ☐ 3/4" ☐ 1" ☐ 1-1/4" ☐ 2" ☐ 3" ☐ 4" ☐ 6" ☐ 8" ☐ 10"
☐ 12" ☐ 14" ☐ 16" ☐ 18" ☐ 20"

Type of Outlet: ☐ Socket ☐ Butt ☐ Mechanical/Insertion ☐ Other: _____

Pressure Class (PSI): ☐ 250 ☐ 200 ☐ 160 ☐ 125

Type Fitting: ☐ Tapping Tee ☐ Branch Tee Other: _____

Typically, dependent on size, fittings are stored indoors and/or in boxes to prevent outside element damage (sun, excessive heat, flooding, etc.) and manufacturing date maybe unknown. Specifications may state maximum duration from manufacture to delivery date.

Damage: Manufacturing Defect: ☐ Non-approved Manufacturer

☐ Out of tolerance ID (outlet)

☐ Wrong Main Diameter

☐ Mismatching

☐ Other: _____

Handling/Shipping: ☐ Weathering (not stored indoors)

☐ Visible damage

Total number of fittings delivered: _____

Number of fittings rejected: _____

Number of fittings accepted: _____